INDOOR AIR QUALITY ASSESSMENT

Hampshire Regional High School
19 Stage Road
Westhampton, Massachusetts

Prepared by:
Massachusetts Department of Public Health
Bureau of Environmental Health Assessment
January 2003

Background/Introduction

At the request of a parent, the Massachusetts Department of Public Health (MDPH), Bureau of Environmental Health Assessment (BEHA) provided assistance and consultation regarding indoor air quality concerns at the Hampshire Regional High School in Westhampton. Concerns of excessive dust within occupied areas of the building attributed to construction/renovation activities prompted the assessment.

Michael Feeney, Director of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, conducted the assessment on October 16, 2002. Mr. Feeney was accompanied by Carl A. Ostrowski, School Principal; Kenneth Smith and Barry Brandow of the Westhampton Board of Health; and Richard Askew, Clerk of the Works. Findings and recommendations concerning renovations were outlined in a letter sent previously (MDPH, 2002). General assessment and air monitoring results are the subject of this report.

The school is a three-story structure that was constructed in 1970. Included in the renovations of the existing building are the additions of two wings to the north wall (see Picture 1) and south wall (see Picture 2) of the original building. At the time of the assessment, neither of the new wings was occupied. Parts of the first and second floors were under renovation. Windows were openable in classrooms.

Methods

Air tests for carbon dioxide, temperature and relative humidity were taken with the TSI, Q-Trak, IAQ Monitor Model 8551.

Results

The school houses ninth through twelfth grades with a student population of approximately 850 and a staff of approximately 100. Tests were taken during normal operations at the school and results appear in Tables 1-3.

Discussion

Ventilation

It can be seen from the tables that carbon dioxide levels were elevated above 800 parts per million parts of air (ppm) in twenty-three of twenty six areas surveyed, indicating inadequate air exchange throughout the building. Please note that the ventilation system was deactivated in a number of areas due to work on the boiler in progress. The univents were reportedly scheduled to be replaced as part of the renovation to the building. New univents in shipping boxes were placed in a number of classrooms. Without an operating ventilation system, carbon dioxide levels within rooms with closed windows would be expected to rise, as demonstrated by the test results (see Tables).

Fresh air in classrooms was supplied by a unit ventilator (univent) system. Univents in exterior classrooms draw air from outdoors through a fresh air intake located on the exterior walls of the building and return air through an air intake located at the base of each unit (see Figure 1). None of the univents were operating during the assessment; therefore, no outside air was being introduced. Obstructions to airflow (once univents are reactivated), such as papers and books stored on univents and bookcases, carts and desks in front of univent returns were seen in a number of classrooms. In order for univents to provide fresh air as designed, intakes must remain free of obstructions. Importantly, these units must remain "on" and allowed to operate while these rooms are occupied. Each univent is equipped with a filter. Operation of univents will also aid in the reduction of dust in classrooms, since visible dust can be removed from air via these filters.

Exhaust ventilation in classrooms is provided by a mechanical system. The exhaust system consists of ducted, grated wall vents powered by rooftop motors. As with the univents, a number of exhaust vents were obstructed, deactivated or in disrepair. In order for exhaust ventilation to function as designed, vents must be activated and remain free of obstructions. With the absence or minimization of mechanical exhaust ventilation, pollutants generated during building occupancy will tend to linger and lead to indoor air/comfort complaints.

To maximize air exchange, the BEHA recommends that both supply and exhaust ventilation operate continuously during periods of school occupancy. In order to have proper ventilation with a mechanical supply and exhaust system, the systems must be balanced to provide an adequate amount of fresh air to the interior of a room while removing stale air from the room. According to school department officials, the date of the last balancing of these systems was not available at the time of the assessment. It is recommended that existing ventilation systems be re-balanced every five years to ensure adequate air systems function (SMACNA, 1994).

The Massachusetts Building Code requires a minimum ventilation rate of 15 cubic feet per minute (cfm) per occupant of fresh outside air or have openable windows in each room (SBBRS, 1997; BOCA, 1993). The ventilation must be on at all times that the room is occupied. Providing adequate fresh air ventilation with open windows and maintaining the temperature in the comfort range during the cold weather season is impractical. Mechanical ventilation is usually required to provide adequate fresh air ventilation.

Carbon dioxide is not a problem in and of itself. It is used as an indicator of the adequacy of the fresh air ventilation. As carbon dioxide levels rise, it indicates that the ventilating system is malfunctioning or the design occupancy of the room is being exceeded. When this happens a buildup of common indoor air pollutants can occur, leading to discomfort or health complaints. The Occupational Safety and Health Administration (OSHA) standard for carbon dioxide is 5,000 parts per million parts of air (ppm). Workers may be exposed to this level for 40 hours/week based on a time weighted average (OSHA, 1997).

The Department of Public Health uses a guideline of 800 ppm for publicly occupied buildings. A guideline of 600 ppm or less is preferred in schools due to the fact that the majority of occupants are young and considered to be a more sensitive population in the evaluation of environmental health status. Inadequate ventilation and/or elevated temperatures are major causes of complaints such as respiratory, eye, nose and throat irritation, lethargy and headaches. For more information concerning carbon dioxide, please consult Appendix I.

Temperature measurements ranged from 68° F to 76° F, which were close to the BEHA comfort guidelines. The BEHA recommends that indoor air temperatures be maintained in a range of 70 ° F to 78 ° F in order to provide for the comfort of building occupants. In many cases concerning indoor air quality, fluctuations of temperature in occupied spaces are typically experienced, even in a building with an adequate fresh air supply. It is also difficult to control temperature without the mechanical ventilation system operating as designed (e.g. univents and exhaust vents deactivated).

The relative humidity measured in the building ranged from 45 to 57 percent, which was within the BEHA recommended comfort range. The BEHA recommends a comfort range of 40 to 60 percent for indoor air relative humidity. Relative humidity levels in the building would be expected to drop during the winter months due to heating. The sensation of dryness and irritation is common in a low relative humidity environment. Low relative humidity is a very common problem during the heating season in the northeast part of the United States.

Microbial/Moisture Concerns

Several classrooms contained a number of plants. Plant soil and drip pans can serve as a source of mold growth. Plants should also be located away from univents to prevent aerosolization of dirt, pollen or mold.

Other Concerns

Several conditions that can potentially affect indoor air quality were also identified. Of note is the design of the ventilation system for the chemical storage area. It appears that this area was designed to have air exhausted via a chemical hood (see Picture 3). The chemical hood was deactivated during this assessment. In order to provide an adequate air supply from the interior of the building (called transfer air, i.e., air that is transferred from one area to another), it appears that a passive vent was installed in the interior hallway wall (see Picture 4) to allow for adequate operation of the chemical hood. This design can prevent odors and vapors from stored chemicals which may evaporate in the chemical storeroom ***if*** the chemical hood is operating. Since the chemical hood is deactivated, possible odors and vapors from the chemical storeroom can enter the hallway through this vent or adjacent classrooms through interior doors. To avoid this circumstance, the chemical hood should operate continuously.

Exposed fiberglass insulation was used to block airflow from renovation sites into occupied areas (see Picture 5). Also of note was the amount of materials stored in some areas. In many classrooms and common areas, items were seen piled on windowsills, tabletops, counters, bookcases and desks. The large amount of items stored provides a means for dusts, dirt and other potential respiratory irritants to accumulate. These stored items (e.g., papers, folders, boxes, etc.) also make it difficult for custodial staff to clean. Household dust and fiberglass particulates can become easily aerosolized and serve as a source of eye and respiratory irritation. In addition, fiberglass insulation material can also serve as a source of skin irritation to sensitive individuals.

The teachers' lounge contained four photocopiers. Volatile organic compounds (VOCs) and ozone can be produced by photocopiers, particularly if the equipment is older and in frequent use. Ozone is a respiratory irritant (Schmidt Etkin, D., 1992). This area was not equipped with local exhaust ventilation to help remove excess heat and odors. The nurse's office contained an ozone generator (see Picture 6). At this time, the efficacy of ozone as an indoor air cleaner is being examined by several government agencies. While ozone may be effective in removing some odors of biological origin (such as skunk), its use as a universal air cleaner has come under question (USEPA, 1998). Until more definitive information becomes available, the use of ozone generators in occupied areas should be done with caution.

Several classrooms contained dry erase boards and dry erase board markers. Materials such as dry erase markers and dry erase board cleaners may contain volatile organic compounds (VOCs), (e.g., methyl isobutyl ketone, n-butyl acetate and butyl-cellusolve) (Sanford, 1999), which can also be irritating to the eyes, nose and throat.

The floor and walls of the art room were stained with clay dust and residue (see Pictures 7 and 8). The most notable stains were located around pottery wheels. Water and wet clay spinning off the wheel had coated the floor. Clay dust can be an eye, nose and throat irritant.

The storage closet of the science classroom had a number of mercury filled thermometers (see Picture 9). Breakage of these glass thermometers can result in an accidental discharge of mercury within the classroom environment.

Conclusions/Recommendations

In view of the findings at the time of this assessment, the following recommendations are made:

1. Implement recommendations listed in previous BEHA correspondence (MDPH, 2002; see Appendix II).
2. Use openable windows to provide fresh air as needed. Operate univents with fresh air damper closed when windows are open to provide particle filtration. Be sure to close windows after hours to prevent pipe freezing.
3. Ensure the mechanical ventilation system is properly balanced by an HVAC engineering firm once renovations are complete.
4. Operate the chemical hood continuously.
5. Replace the ozone generator in the nurse's office with a stand-alone air filter device equipped with a high efficiency particulate arrestance (HEPA) filter. Consider acquiring a device that meets manufacturer's standards for air filtration, such a those standards set forth by the Association of Home Appliance Manufacturers (AHAM), which has set forth a room cleaner certification program for measuring the performance of portable air cleaning devices (US EPA, 2002).

6. Wet mop the floor in pottery wheel room immediately after use to control clay dust accumulation.

7. For buildings in New England, periods of low relative humidity during the winter are often unavoidable. Therefore, scrupulous cleaning practices should be adopted to minimize common indoor air contaminants whose irritant effects can be enhanced when the relative humidity is low. To control for dusts, a high efficiency particulate arrestance (HEPA) filter equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended. Drinking water during the day can help ease some symptoms associated with a dry environment (throat and sinus irritations).

8. Encapsulate exposed fiberglass in occupied areas; consider covering with plastic sheeting and securing with duct tape.

9. Relocate or consider reducing the amount of materials stored in classrooms to allow for more thorough cleaning of classrooms. Clean items regularly with a wet cloth or sponge to prevent excessive dust build-up.

10. Consider installing local exhaust ventilation in teacher's workroom to remove excess heat and odors.

11. Replace mercury-containing thermometers. Dispose of mercury containing thermometers in a manner consistent with Massachusetts hazardous waste disposal laws.

References

BOCA. 1993. The BOCA National Mechanical Code/1993. 8th ed. Building Officials and Code Administrators International, Inc., Country Club Hill, IL. Section M-308.1.1.

MDPH. 2002. Letter to Kenneth Smith, Agent, Westhampton Board of Health from Suzanne Condon, Assistant Commissioner, Bureau of Environmental Health Assessment concerning Renovations at the Hampshire Regional High School, Dated October 29, 2002. Massachusetts Department of Public Health, Bureau of Environmental Health Assessment, Boston, MA.

OSHA. 1997. Limits for Air Contaminants. Occupational Safety and Health Administration. Code of Federal Regulations. 29 C.F.R 1910.1000 Table Z-1-A.

Sanford. 1999. Material Safety Data Sheet (MSDS No: 198-17). Expo® Dry Erase Markers Bullet, Chisel, and Ultra Fine Tip. Sanford Corporation. Bellwood, IL.

SBBRS. 1997. Mechanical Ventilation. State Board of Building Regulations and Standards. Code of Massachusetts Regulations. 780 CMR 1209.0.

Schmidt Etkin, D. 1992. Office Furnishings/Equipment & IAQ Health Impacts, Prevention & Mitigation. Cutter Information Corporation, Indoor Air Quality Update, Arlington, MA.

SMACNA. 1994. HVAC Systems Commissioning Manual. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

US EPA. 2002. Ozone Generators That Are Sold As Air Cleaners: An Assessment of Effectiveness and Health Consequences. US Environmental Protection Agency, Washington, DC. http://www.epa.gov/iaq/pubs/ozonegen.html

U.S. EPA. 1998. Ozone Generators That Are Sold As Air Cleaners. An assessment of Effectiveness and Health Consequences. Indoor Environments Division, Office of Radiation and Indoor Air Programs, Office of Air and Radiation (6604j). Washington, DC.

Picture 1

New North Wing

Picture 2

New South Wing

Picture 3

Chemical Hood

Picture 4

Transfer Air Vent for Chemical Storeroom

Picture 5

Fiberglass insulation used as air plug

Picture 6

Ozone generator

Picture 7

Clay Dust and Water Damage in Art Room

Picture 8

Clay Dust and Water Damage in Art Room

Picture 9

Mercury Containing Thermometers

TABLE 1

Indoor Air Test Results
Westhampton – Hampshire Regional High School – October 16, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Background	332	50	94					
331	814	71	45	8	Y	Y	Y	Exhaust off Door open
333	2029	72	53	13	Y	Y	Y	Exhaust off Supply off, door open
339	1688	72	49	2	Y	Y	Y	Exhaust off, pottery Supply off, door open
330	2914	71	53	23	Y	Y	Y	Exhaust off, supply off Condensation on window
325	2353	71	52	16	Y	Y	Y	Exhaust off Supply off, door open
327	2657	71	52	21	Y	Y	Y	Exhaust off Supply off, door open
329	1994	72	49	15	Y	Y	Y	Exhaust off Supply off
New Library	567	68	46	3	Y	N	N	Window open
239	1310	69	50	11	Y	Y	Y	Exhaust off Supply off

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred 600 - 800 ppm = acceptable > 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 2

Indoor Air Test Results
Westhampton – Hampshire Regional High School – October 16, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
Teachers Lounge	1177	70	49	3	Y	Y	Y	Exhaust off, 4 photocopiers Supply off, window and door open
Hall opposite 227								Hole in wall
111 – 115 Hallway	629	68	49	50	N	N	N	Containment
105	1772	76	47	0	Y	Y	Y	Exhaust off, supply off 23 computers
101	1569	73	44	17	Y	Y	Y	Exhaust off, supply off Window open
Cafeteria	1796	69	57	100+	Y	N	N	
Nurse's Office	752	72	47	1	Y	N	N	Ozone generator
319	2789	69	56	17	Y	Y	Y	Exhaust off, supply off Window blocked, dry erase board (DEB)
315	1886	70	50	0	Y	Y	Y	Exhaust off, supply off Window blocked, DEB
312	1563	72	49	1	Y	N	Y	Exhaust off, window open Fan in window

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

TABLE 3

Indoor Air Test Results
Westhampton – Hampshire Regional High School – October 16, 2002

Location	Carbon Dioxide *ppm	Temp. °F	Relative Humidity %	Occupants in Room	Windows Openable	Ventilation		Remarks
						Intake	Exhaust	
307	1962	71	50	18	Y	Y	Y	Exhaust off, supply off Window open
303	1919	72	49	17	Y	Y	Y	Exhaust off, supply off Window open
300A	1906	72	49	2	Y	Y	Y	Exhaust off, 15 computers Supply off
223	1260	69	50	24	Y	Y	Y	Exhaust off, supply off Window open
229	2467	69	54	18	Y	Y	Y	Exhaust off Supply off
214	1497	70	52	16	Y	Y	Y	Exhaust off, supply off Window open
203	1107	71	48	11	Y	Y	Y	Exhaust off, supply off Window open
207	1298	72	51	12	Y	Y	Y	Exhaust off, supply off Plants

*** ppm = parts per million parts of air**
CT = ceiling tiles

Comfort Guidelines

Carbon Dioxide -	< 600 ppm = preferred
	600 - 800 ppm = acceptable
	> 800 ppm = indicative of ventilation problems
Temperature -	70 - 78 °F
Relative Humidity -	40 - 60%

Appendix II

The Commonwealth of Massachusetts
Executive Office of Health and Human Services
Department of Public Health
Bureau of Environmental Health Assessment
250 Washington Street, Boston, MA 02108-4619

JANE SWIFT
GOVERNOR

ROBERT P. GITTENS
SECRETARY

HOWARD K. KOH, MD, MPH
COMMISSIONER

October 29, 2002

Kenneth Smith, Health Agent
Westhampton Board of Health
Town Hall
Westhampton, MA 01746

Dear Mr. Smith:

As you know, after consultation with your office and the Hampshire Regional School Department, upon receiving a complaint from a parent, the Bureau of Environmental Health Assessment (BEHA) was invited to conduct an evaluation of the indoor air quality at the Hampshire Regional High School. Concerns of excessive dust within occupied areas of the building attributed to construction/renovation activities prompted the assessment. Michael Feeney, Director of Emergency Response/Indoor Air Quality (ER/IAQ), BEHA, conducted the assessment on October 16, 2002. Mr. Feeney was accompanied by Carl A. Ostrowski, School Principal; Barry Brandow, Westhampton Board of Health; Richard Askew, Clerk of the Works and you. Preliminary information concerning renovations is the subject of this letter. General assessment and air monitoring results will be subject of a separate report.

The school is currently under renovation while occupied by students, teachers and administrative staff. It was reported that plans to renovate the entire school are underway. At the time of the inspection, a significant portion of the first floor and portions of the north and south sections of the school were all under renovation. Temporary walls were erected in several areas to separate construction zones from occupied areas. The contractor was in the process of improving containment between buildings, using a combination of temporary walls, polyethylene plastic and duct tape around pipe penetrations (see Picture 1). Several areas continue to have spaces in the temporary walls, unsealed holes in floors (see Picture 2), open pipe conduits that transverse shared walls/floors between renovation and occupied spaces (see Picture 3) and minimal/no containment around doors (see Picture 4) were observed in various areas.

While pathways for renovation-generated pollutants exist between the construction sites and occupied areas, several other conditions within the occupied space are contributing to the accumulation of dust. Both unit ventilators and unit ventilator exhaust vents were deactivated in classrooms evaluated. The deactivation of these components of the heating, ventilating and air-conditioning (HVAC) system can lead to an increased concentration of normally occurring dust that is generated during occupancy. This accumulation can be exacerbated by the generation of construction dust penetrating into occupied areas. The operation of ventilation system components can serve to reduce concentration and accumulation of dust in classrooms for the following reasons:

1. Univents introduce fresh air into classrooms. Introduction of fresh air can serve to dilute airborne concentrations of particles.
2. Univents are equipped with filters that can strain airborne particles from air. The operation of univents can serve as a constantly operating, stationary "vacuum cleaner" that can assist in removing airborne dust.
3. The exhaust ventilation system provides a means to remove stale air and other pollutants from a room. The univent exhaust vents assist in removing normally occurring dust and particles from the building.

For these reasons, operation of the existing ventilation system can aid in the overall reduction of accumulated dust within occupied areas of the building.

School custodial staff were observed using push brooms to clean halls and classrooms. Under normal building operations, the use of push brooms is an adequate means to remove accumulated dirt from the school. Since this building is under renovation, push brooms may be inadequate to remove the additional accumulated dust generated by the renovations. More efficient means to physically remove accumulated dust ought to be employed for buildings undergoing renovations while occupied. The use of high efficiency particle arrestance (HEPA) filter equipped vacuum cleaners can help to remove accumulated particles while preventing aerosolization and subsequent spread of dust.

In order to assess whether containment measures were effective to prevent pollutant migration from construction areas into occupied areas of the high school, air monitoring for ultrafine particles (UFPs) was conducted. Carbon monoxide air levels were also measured. Air tests for carbon monoxide were taken with the TSI, Q-Trak ™, IAQ Monitor Model 8551. Air tests for ultrafine particulates were taken with the TSI, P-Trak ™ Ultrafine Particle Counter Model 8525. The tests were taken under normal operating conditions. Test results appear in Tables 1-3.

During the assessment detectable levels [1 to 3 parts per million (ppm)] of carbon monoxide were recorded in a number of areas within the building (see Tables). The US Environmental Protection Agency has established National Ambient Air Quality Standards (NAAQS) for exposure to carbon monoxide in outdoor air. Carbon monoxide levels in outdoor air must be maintained below 9 ppm over a twenty-four hour period in order to meet this standard (US EPA, 2000). No carbon monoxide measurements exceeded the NAAQS for carbon monoxide during the assessment.

The combustion of fossil fuels, welding, steel cutting, concrete/brick boring and other renovation activities can produce particulate matter that is of a small diameter (<10 µm) (UFPs), which can penetrate into the lungs and subsequently cause irritation. For this reason a device that can measure particles of a diameter of 10 µm or less was used to identify pollutant pathways from the renovation site into occupied areas.

The instrument used by BEHA staff to conduct air monitoring for UFPs counts the number of particles that are suspended in a cubic centimeter (cm^3) of air. This type of air monitoring is useful in that it can track and identify the source of airborne pollutants by counting the actual number of airborne particles. The source of particle production can be identified by moving the UFP counter through a building towards the highest measured concentration of airborne particles. Measured levels of particles/cm^3 of air increase as the UFP counter is moved closer to the source of particle production. While this equipment can ascertain whether unusual sources of ultrafine particles exist in a building or that particles are penetrating through spaces in doors or walls, it cannot be used to quantify whether the NAAQS PM_{10} standard was exceeded. The primary purpose of these tests at the school was *to identify and reduce/prevent pollutant pathways*. Air monitoring for UFPs was conducted in classrooms and hallways and other areas, which may be directly impacted from close proximity to renovation sites. For comparison, measurements in areas away from renovation sites indoors as well as outdoors were taken. Increased levels of UFPs over background levels taken in the interior of the school were noted in some areas, with the highest concentrations around a wall opening filled with fibrous glass insulation (see Picture 5). The source of this higher UFP count was the cutting of steel beams in the new library. These particles can pass into the 300A hallway through spaces in the insulation. In addition, higher UFP count was also measured in the rear of the cafeteria near doors to a hallway with pipe cutting equipment. These rear hallway cafeteria doors do not have containment (see Picture 4). Across the hall from these doors is the boiler room, which is under renovation and also had its hallway doors propped open (see Picture 4). Both pipe cutting and boiler room equipment can be sources of UFPs. The level of UFPs indicates that particulates from construction activities are penetrating into occupied space in this area.

A number of conditions that influence the movement of air from renovation areas into occupied areas were observed. These include:

1. *Temperature Differentiation between Renovation and Occupied Spaces*: The renovation areas are open to the outdoors. Temperature in the renovation areas should be expected to have a lower temperature than occupied areas during the heating season. This temperature differentiation can result in movement of cold air from the renovation site to warmer air, creating drafts that can penetrate through cracks, crevices, holes and seams in interior and containment walls, resulting in the introduction of renovation generated pollutants (e.g. vehicle exhaust, particulates) into occupied areas.

2. *Occupied Areas Are under Negative Pressure:* The operation of classroom exhaust vents combined with deactivated or poorly operating unit ventilators creates negative pressure. If classrooms are under negative pressure (similar to a vacuum effect), air and pollutants from the renovation areas can be drawn into classrooms through cracks, crevices, holes and seams in interior and containment walls.

3. *The Renovation Areas Are under Positive Pressure*-The renovation areas can become pressurized during westerly winds. A number of open-air penetrations exist in the exterior wall. A steady westerly or easterly wind can force air into the renovation area, which creates positive air pressure. If pressurized, air and pollutants from the renovation areas can be forced into classrooms through cracks, crevices, holes and seams in interior and containment walls.

The carbon monoxide and ultrafine particulate air testing indicated that seams (some sealed with duct tape) and spaces in temporary containment walls are not sufficient to prevent pollutant migration into occupied areas. Measures should be taken to reverse the air pressure relationship between the renovation areas and occupied spaces. Univents in all occupied classrooms should be operating to create positive pressure in classrooms. Once all univents are operating, general exhaust ventilation in classrooms should be reduced to maintain a slightly positive air pressure in classrooms.

Despite measures taken thus far to limit pollutant migration into occupied areas, numerous pathways still exist for pollutants to move from areas under renovation into occupied spaces. In addition to changing the pressure relationships of the occupied space to the areas under renovation, the following recommendations should be implemented as soon as possible in order to reduce the migration of renovation generated pollutants into occupied areas and to better address indoor air quality concerns:

1. Establish communications between all parties involved with building renovations to prevent potential IAQ problems. Develop a forum for occupants to express concerns about renovations as well as a program to resolve IAQ issues.

2. Develop a notification system for building occupants immediately adjacent to construction activities to report construction/renovation related odors and/or dusts problems to the building administrator. Have these concerns relayed to the contractor in a manner to allow for a timely remediation of the problem.

3. When possible, schedule projects which produce large amounts of dusts, odors and emissions during unoccupied periods or periods of low occupancy.

4. Disseminate scheduling itinerary to all affected parties, this can be done in the form of meetings, newsletters or weekly bulletins.

5. Obtain Material Safety Data Sheets (MSDS) for all construction materials used during renovations and keep them in an area that is accessible to all individuals during periods of building operations as required by the Massachusetts Right-To-Know Act (MGL, 1983).

6. Consult MSDS' for any material applied to the affected area during renovation(s) including any sealant, carpet adhesive, tile mastic, flooring and/or roofing materials. Provide proper ventilation and allow sufficient curing time as per the manufacturer's instructions concerning these materials.

7. Use local exhaust ventilation and isolation techniques to control for renovation pollutants. Precautions should be taken to avoid the re-entrainment of these materials into the building's HVAC system. The design of each system must be assessed to determine how it may be impacted by renovation activities. Specific HVAC protection requirements pertain to the return, central filtration and supply components of the ventilation system. This may entail shutting down systems (when possible) during periods of heavy construction and demolition, ensuring systems are isolated from contaminated environments, sealing ventilation openings with plastic and utilizing filters with a higher dust spot efficiency where needed (SMACNA, 1995).

8. Seal utility holes, spaces in and around temporary walls and holes created by missing ceiling tiles to eliminate pollutant paths of migration.

9. Seal all doors that access renovations with polyethylene plastic and duct tape.

10. Consider installing an air lock in areas that lead from the construction areas to the occupied section of the building. An airlock can be established by erecting a temporary wall with a door in close proximity to either an existing wall with door or another temporary wall with door (see Figure 1). Each wall should be covered with continuous sheets of polyethylene plastic adhered with duct tape to seals seams in each airlock wall. Each door should be equipped with weather-stripping and a door sweep to prevent air movement through seams once the door is closed. Each door of the airlock should be equipped with a spring to automatically close the door. This configuration serves to prevent renovation generated pollutants from penetrating into occupied space. In order to prevent dust spread, a floor covering to aid in removal of particle debris from workers shoes (walk-off mat) should be installed on the floor of the air lock. Another walk-off mat (approximately five feet in length should be installed in the occupied side of the airlock. The purpose of walk-off mats is to limit the spread of dust from workers walking from the renovation side in occupied areas. Each walk-off mat should be cleaned with a HEPA filter equipped vacuum daily, or more frequently if needed.

11. An airlock should be installed in the back doors of the cafeteria. Ensure that the doors of each airlock are properly marked with fire egress instructions.

12. If possible, relocate susceptible persons and those with pre-existing medical conditions (e.g. hypersensitivity, asthma) away from areas of renovations.

13. Implement prudent housekeeping and work site practices to minimize exposure to renovation pollutants. This may include constructing barriers, sealing off areas, and temporarily relocating furniture and supplies. To control for dusts, a high efficiency particulate arrestance filter (HEPA) equipped vacuum cleaner in conjunction with wet wiping of all surfaces is recommended.

We suggest that most of these steps be taken on any renovation project within a public building. Please feel free to contact us at (617) 624-5757 if you are in need of further information or technical assistance.

Respectfully,

Suzanne K. Condon, Assistant Commissioner
Bureau of Environmental Health Assessment

cc/ Mike Feeney, Director, Emergency Response/Indoor Air Quality, BEHA
Charles Kaniecki, MDPH, Northampton Regional Office
William G Erickson, District Superintendent, Hampshire Regional School District
Carl A. Ostrowski, School Principal, Hampshire Regional High School
Barry Brandow, Westhampton Board of Health
Chesterfield Board of Health
Maxine Schmidt, RS, Agent, Foothills Health District
Geraldine Swanson, Southampton Board of Health
Senator Stanley C. Rosenberg
Senator Michael R. Knapik
Representative Shaun P. Kelly
Representative Stephen Kulik

References

MGL. 1983. Hazardous Substances Disclosure by Employers. Massachusetts General Laws. M.G.L. c. 111F.

SMACNA. 1995. IAQ Guidelines for Occupied Buildings Under Construction. 1st ed. Sheet Metal and Air Conditioning Contractors' National Association, Inc., Chantilly, VA.

US EPA. 2000. National Ambient Air Standards (NAAQS). . US Environmental Protection Agency, Office of Air Quality Planning and Standards, Washington, DC. http://www.epa.gov/air/criteria.html.

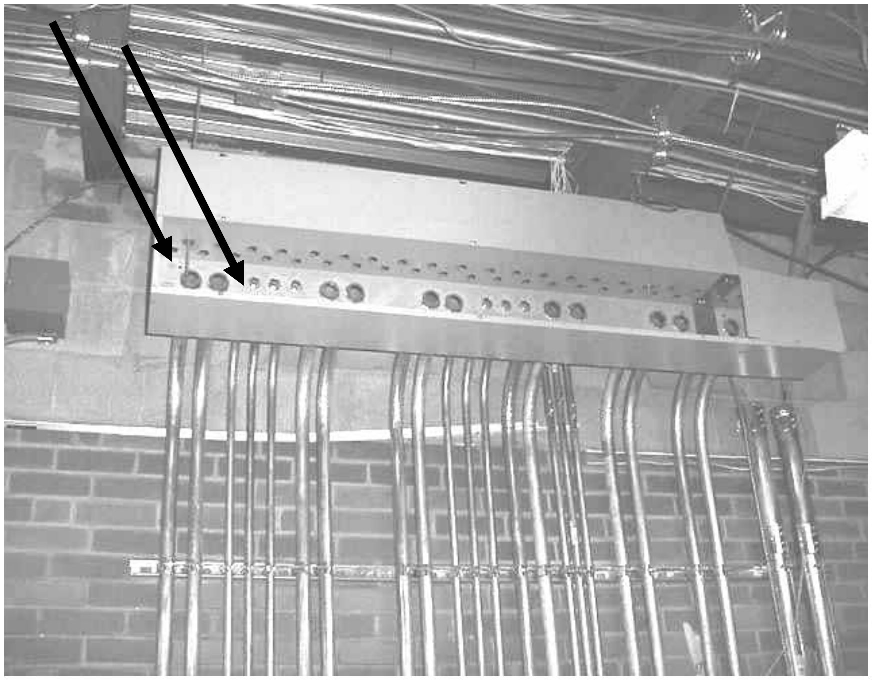
Picture 1

Pipe Penetrations Sealed with Duct Tape

Picture 2

Unsealed Hole in Floor

Picture 3



Uncapped Electrical Conduits

Picture 4

Minimal Containment around Cafeteria Doors

Picture 5

Fibrous Glass Used as a Plug in the 300A Hallway

TABLE 1

Carbon Monoxide and Particulate Testing

Hampshire Regional High School, Westhampton, MA – October 16, 2002

Area	Location in Area	Number of Ultrafine Particulates Particles per cc of air (in thousands)[a]	Carbon Monoxide *ppm
Outside (Background)	Side of building	23	0
332	Center of room	12	1
AV Room	Missing bricks above ceiling	111	1
M4	Center of room	13	1
216	Center of room	11	1
M6	At holes in common wall	24	1
M3	Center of room	11	1
207	Center of room	9	1
205	Center of room	11	1
S4	Center of room	10	1
Gymnasium	Center of room	10	1
Guidance	Center of room	8	0
Health	Center of room	0	7

* ppm = parts per million

[a] Device measures total airborne particulates of a diameter 0.02-1 micrometers

TABLE 2

Carbon Monoxide and Particulate Testing

Hampshire Regional High School, Westhampton, MA – October 16, 2002

Area	Location in Area	Number of Ultrafine Particulates Particles per cc of air (in thousands)[a]	Carbon Monoxide *ppm
Hallway	Holes in wall above soda machine	106	0
Mac computer Room	Center of room	23	1
Shop	Center of room during sawing of metal shelf supports	42	0
103	Center of room	11	1
102	Center of room	11	1
109	Center of room	8	1
Library	Center of room	8	1

* ppm = parts per million

[a] Device measures total airborne particulates of a diameter 0.02-1 micrometers